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A5R RECX

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(58) Field of Search
UK CL (Edition O) A5R RECX REE, B4B
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(54) **Surgical Knives**

(57) In a surgical knife, especially for ophthalmic surgery, a diamond blade (14) protrudes at the forward end of a handle (22) through a footplate (16) which in use is placed on the tissue to be incised, for example a cornea. The handle (22) and blade (14) are jointly pivotable relative to the footplate (16) so that with the footplate anchored in position on the tissue a pivoting movement of the handle causes the blade (14) to traverse a cutting path. By making the contact surface (30) curved for example, the depth of cut can be increased (x) as the path is traversed. The contact surface (30) of the footplate (16) is preferably shaped, for example castellated, to inhibit sliding of the footplate over the tissue. The handle may incorporate a micrometer setting device (12).

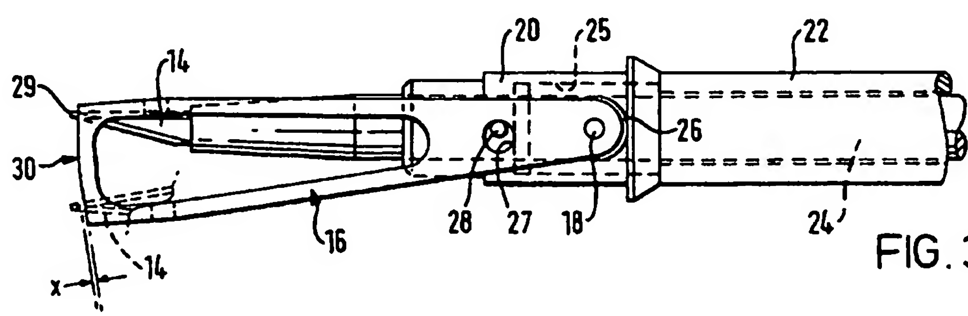

FIG. 3

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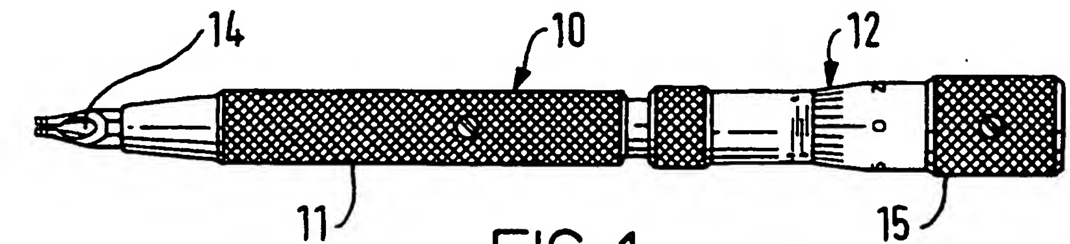

FIG. 1

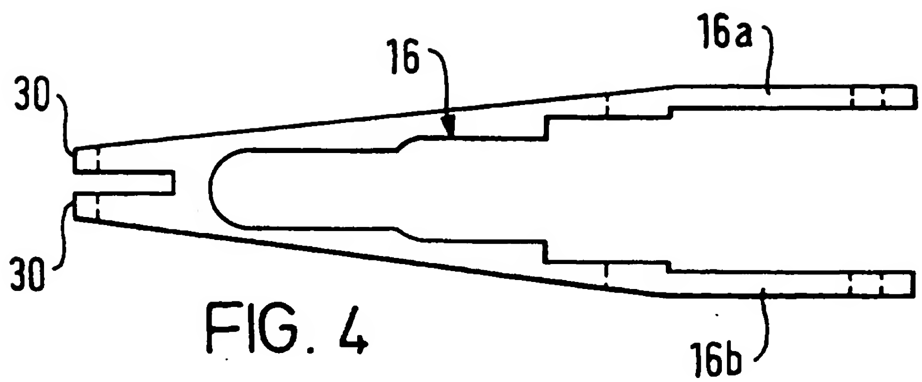

FIG. 4

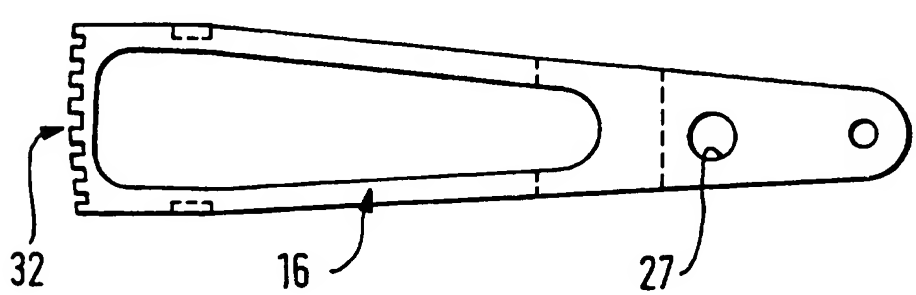

FIG. 5

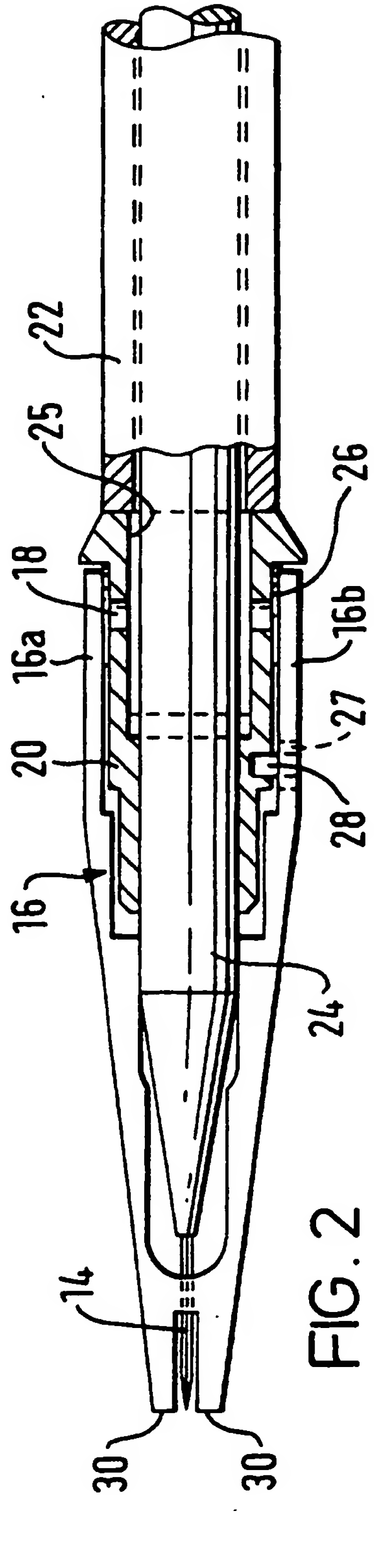
22
25
26
18
16a
16b
27
20
28
16
24
14
30
30

FIG. 2

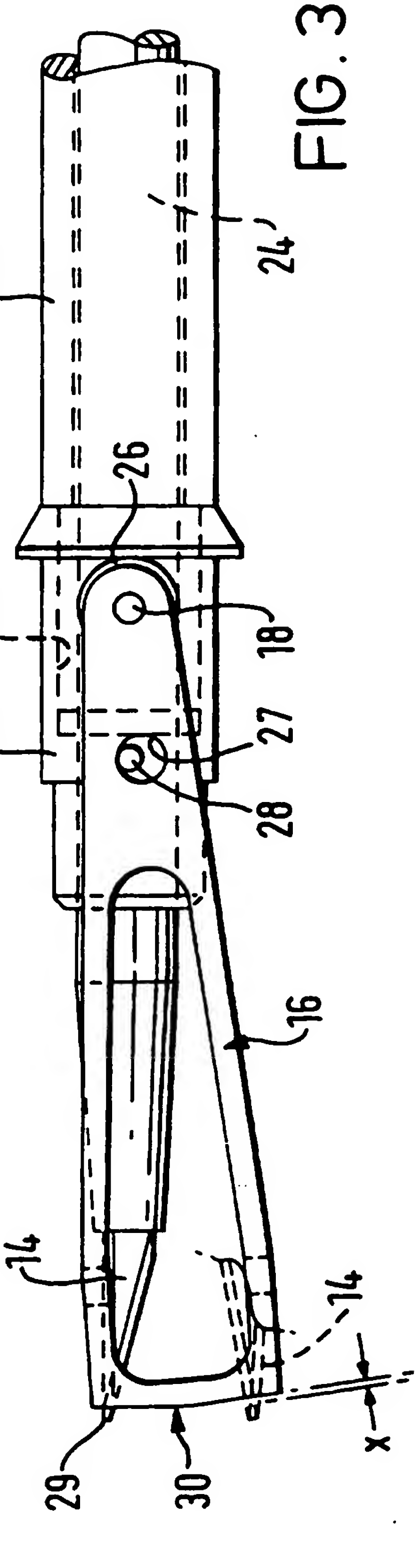
22
24
26
25
18
20
27
28
16
14
14
x
29
30

FIG. 3

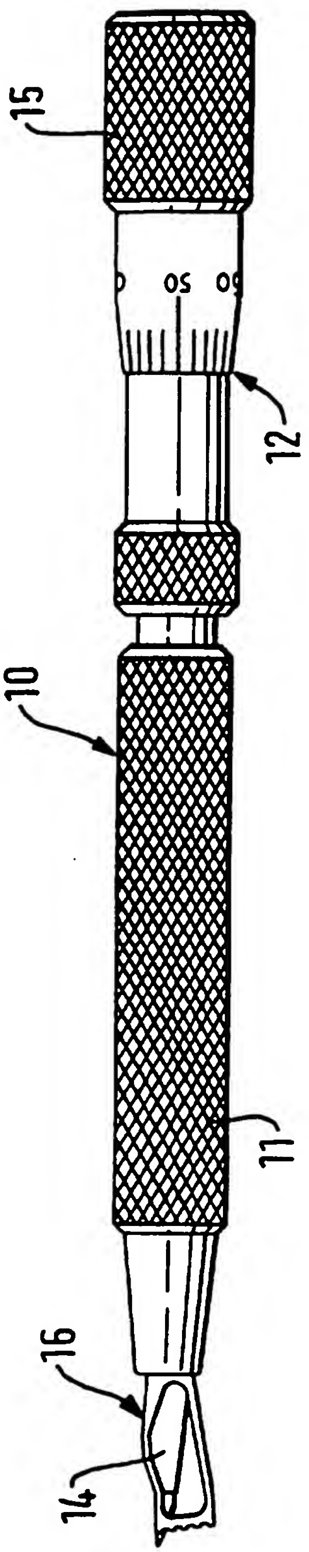

FIG. 6

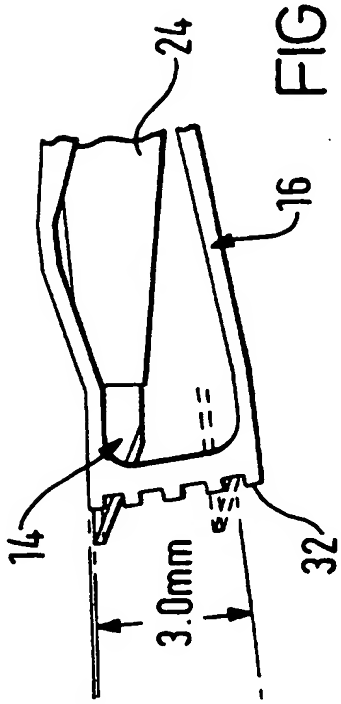

FIG. 7

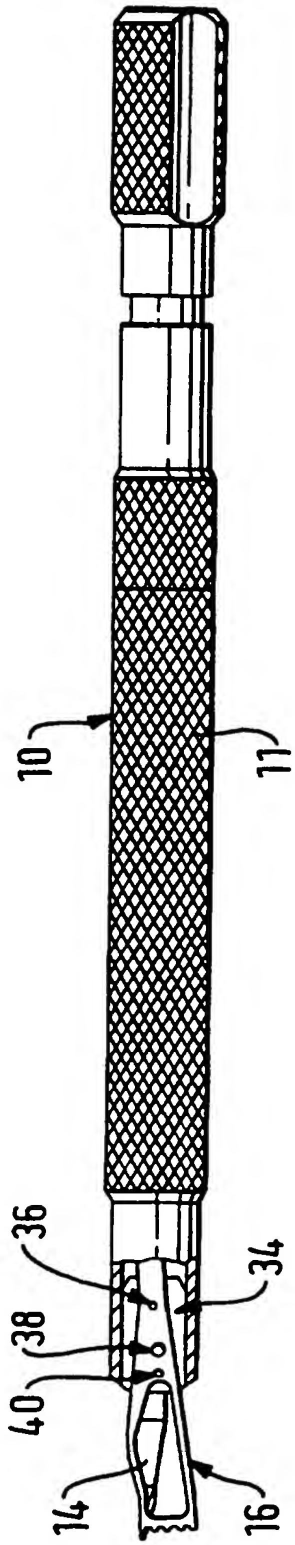

FIG. 8

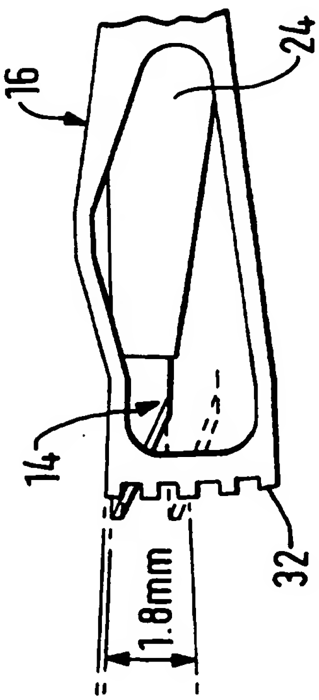

FIG. 9

SURGICAL KNIVES

This invention relates to diamond knives used in ophthalmic surgery, and is particularly concerned with knives for use in refractive or corrective surgery where incisions are made in the cornea.

Diamond knives for ophthalmic surgery are known where the leading end of the knife has a footplate which rests on the surface to be cut and through which the diamond blade projects by a variable amount, usually under the control of a micrometer adjustment mechanism. However, once the blade has been set, the surgeon has then to draw the blade over the surface in what is essentially a freehand movement.

To correct certain optical defects in the eye, surgeons make incisions in the cornea in order to "flatten" the cornea, so that the refractive characteristics of the eye are changed. There is an optical zone of 3 to 3.5 mm diameter at the centre of the cornea which must be left untouched. Radially outward incisions are made from the periphery of this zone, generally each of a length of the order of 3 mm. Four to eight radial incisions is customary. The incisions are made only partially through the thickness of the cornea. After the incisions have been made the cornea will flatten itself.

One of the problems of such surgery is that the cornea is not of constant thickness over its whole area. It is thinnest in the central optical zone and is of increasing thickness as one travels outwards from that zone. The desirable objective in making these incisions is to cut into the cornea to such a depth that the remaining corneal wall below each incision is of constant thickness over the whole

length of the incision. In other words, one needs to cut gradually deeper as one moves radially outwards from the central optical zone.

It is one object of the present invention to provide a surgical knife which facilitates the cutting of incisions to predetermined dimensions in a more controlled manner.

It is a further object of the invention to provide a surgical knife with which one can make incisions which increase in depth as one traverses from one end of the incision to the other.

In accordance with the invention there is provided a surgical knife which comprises a handle, a diamond cutting blade at the forward end of the knife, and a footplate at the forward end of the knife through which the blade can protrude,

wherein the footplate has at least one surface arranged to be located on tissue to be incised,

and wherein the handle and blade are arranged for joint pivotal movement relative to the footplate so that with said footplate surface anchored on the tissue a pivoting movement of the handle will cause the blade to traverse a cutting path across the tissue.

Preferably, the pivoting movement of the handle relative to the footplate causes the blade cutting depth to change as the cutting path is traversed.

Preferably, the end of the footplate which is placed in contact with the surface of the cornea is provided with castellations, indentations, grooves, roughness or the like so that there is a reduced tendency for the footplate to slip relative to the cornea as the incision is made.

A further advantage of having the footplate in contact with the cornea as the incision is made is

that one has support for the blade and is not working "freehand". Moreover, a straight cut is ensured.

In one preferred embodiment of the invention, using a footplate having a curved forward end face, one can obtain an increase in the depth of cut of 0.035 mm over an incision length of 3 mm.

In order that the invention may be more fully understood, presently preferred embodiments of knife in accordance with the invention will now be described by way of example and with reference to the accompanying drawings, in which:

Fig. 1 shows a conventional diamond knife for use in ophthalmic surgery, having a micrometer adjustment;

Fig. 2 is a top plan view of the front end of a diamond knife in accordance with the invention, fitted with a pivotable footplate;

Fig. 3 is a side view of the knife shown in Fig. 2;

Fig. 4 is a top plan view of just the pivotable footplate;

Fig. 5 is a side view of a pivotable footplate which has a castellated surface at the leading end of the footplate;

Fig. 6 is a side view of a second embodiment of knife in accordance with the invention;

Fig. 7 is a detail view of the front end of the knife shown in Fig. 6;

Fig. 8 is a side view of a third embodiment of knife in accordance with the invention;

Fig. 9 is a detail view of the front end of the knife shown in Fig. 8.

Fig. 1 shows a conventional single pitch diamond knife 10 having a knurled handle 11 and a micrometer adjustment 12 at the rearward end of the

handle to enable a diamond blade 14 which protrudes from the forward end of the knife to be set for a prescribed cutting depth. Rotation of the rear end portion 15 of the knife will vary the cutting depth of the blade.

Figs. 2 and 3 show how the conventional knife of Fig. 1 is modified in accordance with the present invention. A generally U-shaped footplate 16 having side arms 16a, 16b is pivotably mounted by means of a pair of pivot pins 18 on a footplate pivot member 20 which is fitted to a sleeve body 22 of the knife. A straight rod 24 carrying the diamond blade 14 at its forward end extends longitudinally through the sleeve body 22 and the pivot member 20. The pivot member 20 has a bore through its forward part in which the rod 24 is a sliding fit, and has a counterbore 25 at its rearward end. An annular washer 26 is provided between each arm of the footplate 16 and the pivot member 20. One arm 16b of the footplate is provided with a circular hole 27 forwardly of the pivot pins 18. Received in this hole 27 is a stop pin 28 which projects from the pivot member 20, as shown most clearly in Fig. 3. The cooperation of the stop pin 28 and the hole 27 limits the pivotal movement of the footplate relative to the handle of the knife.

As can be seen most clearly in Fig. 3, the diamond blade 14 is generally triangular at its leading end and is provided with two cutting surfaces. The tip of the blade, indicated at 29, can protrude beyond the leading end face 30 of the footplate 16. As shown in Figs. 2 and 4, the end face 30 of the footplate is in fact two spaced parallel faces with the blade 14 between them. The end face 30 of the footplate 16 is slightly curved, as shown in Figs. 3 and 5. This end face 30 is

preferably indented or castellated, as indicated at 32 in Fig. 5, although alternatives such as grooves and ribs or roughening may be used. The purpose of the surface finish is to prevent this end surface 30 from slipping when it is placed against the cornea during surgery. By having a non-smooth surface one gains additional "grip" when the pivoting movement takes place. The curvature of the end surface 30 of the footplate 16 is such that the blade tip 29 protrudes from the footplate by a different amount when it is in the upper position as indicated in solid lines in Fig. 3 as compared with when it is in its lowest position as indicated by broken lines in Fig. 3. This difference is indicated at 'x' in Fig. 3. For example, if the tip 29 is set flush with the end face 30 in the upper position, it will protrude by for example 0.035 mm when in the lowest position. The travel distance from the upper position to the lower position is of the order of 3 mm. This is the length of the incision which is to be made. If the blade is set to protrude by 0.600 mm in the upper position, then it will protrude by 0.635 mm in the lowest position. The blade width of the tip 29 is of the order of 0.2 mm.

In use, the surgeon will use the micrometer adjustment 12 on the knife to set the blade 14 to protrude by the desired amount in the upper setting, based upon the thickness of the patient's cornea adjacent to the central optical zone. The divided leading end of the footplate 16 is then placed on the surface of the cornea where it will be held in place, aided, if provided, by the surface indentations or the like on the footplate 16. With the footplate 16 thus held in place, the surgeon simply has to pivot the knife handle 11 and blade 14, thereby causing the

blade to traverse the footplate 16 in an arcuate path as the pivoting movement takes place. The tip 29 of the blade traverses from one end of the footplate to the other, cutting to an increasing depth as it performs this movement.

Figs. 6 and 7 show a pivoting footplate diamond knife which is similar to that of Figs. 1 to 5. The footplate 16 has a slightly different configuration. In this embodiment the dimensions of the castellations 32 at the leading face of the footplate are such that there is no increase in the depth of cut between the upper blade position shown in solid lines and the lower blade position shown in broken lines. A typical setting would have the blade 14 protruding to a depth of 0.6 mm with a length of cut of 3.00 mm from the leading edge of the blade in the upper position to the trailing edge of the blade in the lower position, as indicated in Fig. 7. The tip of the blade is flush with the front face of the footplate in the upper position when the engraved scale on the knife is set at zero.

Figs. 8 and 9 show yet another embodiment of knife. This is a step knife without a micrometer setting mechanism and having just one operating position, with a retractable blade. It finds particular application in the introduction of inlays into the cornea, where there is a need for both the width and the depth of cut to be precise. The same footplate 16 is used here as in Figs. 6 and 7. The length of travel of the blade 14 is shorter, for example 1.8 mm. Again, in this embodiment, there is no increase in the depth of cut of the blade as it undergoes its traverse of the footplate. A typical blade depth for this embodiment is 0.43 mm. In this embodiment the footplate 16 is mounted slightly

differently. It is set for pivoting movement relative to a guard pivot 34. Pivoting takes place about a pair of taper pins 36. A single taper pin 38 corresponds to the stop pin 28 of Fig. 3. A pair of shear pins 40 are also provided.

In contrast to the embodiment described above, where there is a difference in the depth of cut from one side of the footplate 16 to the other resulting from the traverse of the blade 14, but that difference is fixed, i.e. is determined by the configuration of the footplate itself, one could alternatively provide a knife in which the footplate is provided with means to permit the configuration at its leading end to be adjustable so that one can choose in advance how great an increase in the depth of cut is obtained over the length of the traverse.

CLAIMS:

1. A surgical knife comprising a handle, a diamond cutting blade at the forward end of the knife, and a footplate at the forward end of the knife through which the blade can protrude,

wherein the footplate has at least one surface arranged to be located on tissue to be incised,

and wherein the handle and blade are arranged for joint pivotal movement relative to the footplate so that with said footplate surface anchored on the tissue a pivoting movement of the handle will cause the blade to traverse a cutting path across the tissue.

2. A surgical knife according to claim 1, in which the pivoting movement of the handle relative to the footplate causes the blade cutting depth to change as the cutting path is traversed.

3. A surgical knife according to claim 2, in which the depth of cut increases by of the order of 0.035 mm over a path length of the order of 3 mm.

4. A surgical knife according to claim 3, in which the cutting depth increases from of the order of 0.6 mm to of the order of 0.635 mm.

5. A surgical knife according to any preceding claim, in which said at least one footplate surface is such that it inhibits movement of the footplate over the tissue.

6. A surgical knife according to claim 5, in which said at least one footplate surface has castellations to inhibit movement.

7. A surgical knife according to any preceding claim, in which the forward end of the footplate has a pair of parallel curved contact surfaces with the blade positioned to be movable therebetween.

8. A surgical knife according to any preceding claim, in which the footplate is substantially U-shaped with a pair of rearwardly extending limbs connected pivotally to the handle, and with stop means to limit the relative pivotal movement.

9. A surgical knife according to any preceding claim, in which the handle incorporates a micrometer setting mechanism.

10. A surgical knife substantially as hereinbefore described with reference to Figs. 2 to 5, Figs. 6 and 7, or Figs. 8 and 9 of the accompanying drawings.

Amendments to the claims have been filed as follows

1. A surgical knife comprising a handle, a diamond cutting blade at the forward end of the knife, and an integral footplate at the forward end of the knife through which the blade can protrude,

wherein the footplate has at least one surface arranged to be located on tissue to be incised,

and wherein the handle and blade are arranged for joint pivotal movement relative to the footplate so that with said footplate surface anchored on the tissue a pivoting movement of the handle will cause the blade to traverse a cutting path across the tissue.

2. A surgical knife according to claim 1, in which the pivoting movement of the handle relative to the footplate causes the blade cutting depth to change as the cutting path is traversed.

3. A surgical knife according to claim 2, in which the depth of cut increases by of the order of 0.035 mm over a path length of the order of 3 mm.

4. A surgical knife according to claim 3, in which the cutting depth increases from of the order of 0.6 mm to of the order of 0.635 mm..

5. A surgical knife according to any preceding claim, in which said at least one footplate surface is such that it inhibits movement of the footplate over the tissue.

6. A surgical knife according to claim 5, in which said at least one footplate surface has castellations to inhibit movement.

7. A surgical knife according to any preceding claim, in which the forward end of the footplate has a pair of parallel curved contact surfaces with the blade positioned to be movable therebetween.

8. A surgical knife according to any preceding claim, in which the footplate is substantially U-shaped with a pair of rearwardly extending limbs connected pivotally to the handle, and with stop means to limit the relative pivotal movement.

9. A surgical knife according to any preceding claim, in which the handle incorporates a micrometer setting mechanism.

10. A surgical knife substantially as hereinbefore described with reference to Figs. 2 to 5, Figs. 6 and 7, or Figs. 8 and 9 of the accompanying drawings.

The Patent Office

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Claims searched: 1-10

Examiner: Jon Broughton
Date of search: 3 December 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): A5R (RECX, REE); B4B

Int Cl (Ed.6): A61B 17/32; A61F 9/00

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB 2142163 A	(MICROSURGICAL EQUIPMENT LIMITED) see whole document.	
X	US 4688570	(UNIVERSITY OF CALIFORNIA) see column 3 lines 7-56, and figures 6 and 8.	1, 5
A	US 4569133	(SHARPOINT INC.) see whole document.	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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